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SOVIET PRODUCTION TECHNOLOGY OF CAST-IRON SHOT

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Cast-iron shot is classified by designation and size as drilling shot No 2.5, 3.0, 4.0) and technical shot (No 0.7, 1.0, 1.5, 2.0, 5.0). Drilling shot is used in the drilling of wells in connection with geological prospecting, and technical shot is used in the metallurgical, machine building, and other branches of industry for cleaning castings, forged work, and stampings of sand and scale, and for sawing and grinding marble, granite and other minerals. Shot is also widely used to increase the strength of parts by way of shot peening.

Shot is produced from chilled cast iron by pulverizing a stream of liquid cupola iron and cooling it in water with a potassium bichromate solution.

The complex mechanization of a continuous shot production process was accomplished by one plant which used its own resources to plan and produce all the necessary equipment, mechanisms, conveyer devices, and machines for sorting and separating the shot. These operations brought about a twofold increase in the output of sound product. Mechanical operations completely replaced manual labor, shortening the production cycle from a premechanization 40 or 50 hr to 30-40 min. Sound product yield was increased from 55.8% in 1949 to 70%.

The process for obtaining the shot consists of the usual operations during the melting of iron in a cupola and the pouring of shot, channeling the shot from the plant, feeding it into a receiving bin, and drying, heat treating, sorting, and separating it. Final operations involve weighing and packing.

The prepared charge materials are transported by wagon or car through the weighing department and delivered by shaft hoist to the charging platform for melting in one of the cupolas.

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The two "Gipromez"-type cupolas, with three rows of tuyeres have a productivity of 2.5 t/hr and operate alternately (12 hr each per 24-hr day), feeding a shot pit. Air feed into the cupolas is accomplished with individual centrifugal blowers, type TsAGI BP 19 at a head of 450-500 mm water column. The molten metal leaves the cupola at a temperature of 1,320-1,350°C on a 3-m trough inclined 14°. The metal comes out through one of two calibrated openings in the tap hole, 10 and 12 mm in diameter. The 10-mm opening is situated 100-120 mm below the 12-mm opening. After each tapping, the trough is cleaned of slag, and scum, and sprinkled with a casting mixture.

The liquid metal is fed from the trough into the ladle of a teeming car. The ladle, lined with a 30-40 mm thick layer of refractory clay, is mounted on the car at an angle of 3-4° so that its pouring lip is raised 30-40 mm. From the pouring ladle, the stream of liquid metal, with a diameter of 10-12 mm at 1,260-1,280°, drops into the shot pit onto the wet surface of a rotating drum. The length of fall of the stream is controlled, by raising or lowering the car and ladle, from 1,485 to 1,710 mm, depending upon the fluidity of the metal and the diameter of the stream. Fall is decreased as fluidity increased and diameter lessens. For uniform feed of the metal stream over the entire length of the rotating drum, the ladle of the teeming car is moved back and forth by a drive mechanism over 150-350 mm at a rate of eight complete movements per minute. The stream must drop precisely along the drum. Deviation to the right or left of the drum is detrimental to the process of spattering, i.e. the amount of elongated, flattened, or drop-shaped, etc. pellet forms is increased. As the stream of liquid metal strikes the wet surface of the rotating drum, it splatters. The individual drops fall into the water where they cool rapidly, harden, and form pellets of various sizes.

To impart a spherical form to the pellets, the stream of metal, after spattering, must fall through the air for some distance before striking the water. To this end, the water level in the shot pit is maintained so that the drum is submerged by not more than one third of its diameter. The drum, 380 mm in diameter and 1,200 mm long, rotates at 130 rpm on roller bearings situated inside the drum to protect them from the splattering metal.

To provide an anticorrosive coating for the pellets, each cubic meter of water has added to it 300 g of $K_2Cr_2O_7$ and 50 g of KOH or similar quantities of $Na_2Cr_2O_7$ and NaOH. Water temperature is maintained at 50-70°.

Two 50 cu m/hr centrifugal pumps are set up to fill the pit with water. By means of an 80-cu-m reserve tank, the pumps also keep the water at constant level and temperature.

The teeming car and drum are driven off the same 5.8-kw, 1,450-rpm motor by a belt and pulley system. A worm gear drives a large gear wheel with a perimeter-mounted rod attached on the other end to the teeming car to impart the back-and-forth motion described above.

The cylindrical shot pit, 6 m in diameter and 7.45 m in depth, has, in the lower portion, a wall inclined 36° from vertical. The shot, in the process of production, rolls down this wall into a shaft. The shaft adjoins and forms a part of the shot pit. Its function is to facilitate removal of the shot during the pouring process.

Shot pit and shaft walls are of reinforced concrete lined, as is the ceiling of the pit, with 3- to 4-mm steel sheet. The weld seams above the water level are cleaned thoroughly to prevent accumulation of scrap which, during pouring, is removed with a rabble through a hatch in the pit top.

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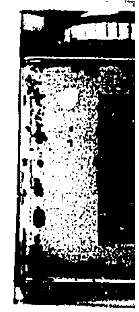

The shot is removed from the shaft by means of an electrically operated grab bucket suspended from a car above the shaft. The bucket picks up about a ton of shot, brings it to the surface at a life speed of 17 m/min and holds it above the water level to let the water drain off for 3-4 min. It is then raised an additional 200-300 mm to clear the edge of a receiving bunker, over which it is carried by the car, moving at 8.5 m/min. It is dropped into the bunker and flows at a constant rate into the drum of a drying and heat treating furnace; which operates at a temperature of 250-300°. Furnace output is 3.5 t/hr.

From the furnace, the shot goes onto a vibrating screen for separation of scrap from the conditioned shot. It is then screened for size and conveyed to separate bunkers and packed. On the way to the bunker, metal dust and scale are separated in a special chamber.

The metal for the shot has the following percentage composition: 3.0-3.5 C; 1.5-2.0 Si; 0.4-0.7 Mn; 0.12 S (max); 0.3-0.8 P. Hardness is 58-60 R_C. Shot of 2.8-3.4 mm diameter splits into 3-5 pieces under a load of 450-500 kg.

Introduction of 0.15% Cr and Ni increases shot hardness to 62 R_C, and raises resistance to crushing by 50 kg.

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